DOCUMENT RESUME

ED 244 835 SE 044 560

AUTHOR Canipe, Stephen
TITLE Carnivorous Plants.
PUB DATE 84
NOTE 37p.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Biology; *Botany; High Schools; *Plant Identification; *Science Activities; Science Education; *Secondary School Science; Units of Study
IDENTIFIERS *Carnivorous Plants

ABSTRACT

This biology lesson on carnivorous (insectivorous) plants is designed to supplement the textbook in the areas of plant diversity, ecology, and distribution. An introduction provides general background information for use as lecture material by the teacher or as reading and/or study material for students. The introduction also includes illustrations of carnivorous plants. Larger drawings of these plants and other illustrations not found in the introduction are included in an appendix. These large drawings are for teachers to use in preparing transparencies. Also included in the appendix are the student objectives, learning activities, list of terms, bibliography, and supply list. (JN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

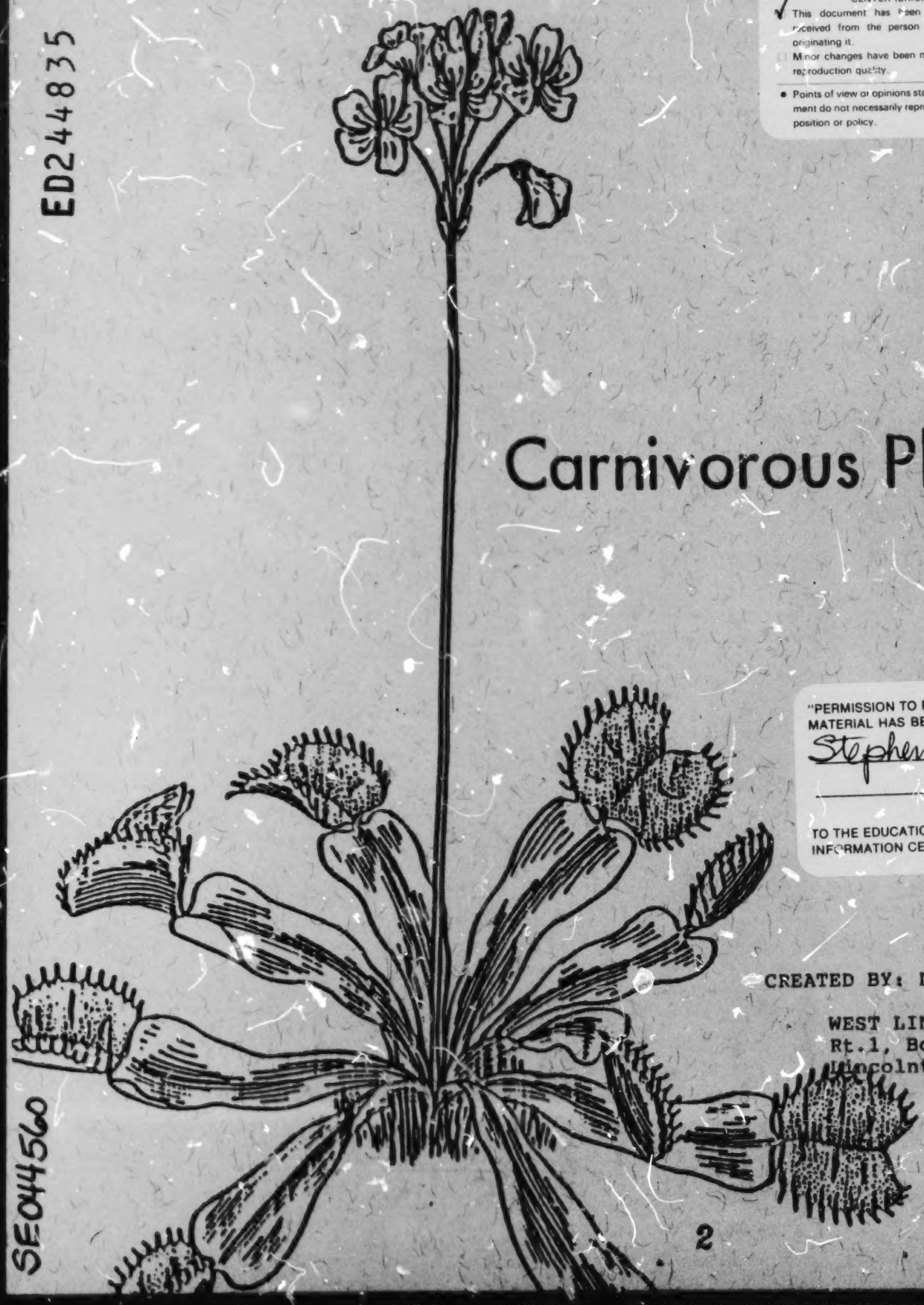
ED244835

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

- [x] This document has been reproduced as received from the person or organization originating it.
- [ ] Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Carnivorous Plants



"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Stephen Canipe
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CREATED BY: Dr. Stephen Canipe
WEST LINCOLN HIGH
Rt.1, Box 363
Lincolnton, NC 28092

84.06.20

SE044560

TO THE TEACHER

This biology lesson is designed to supplement the textbook in the areas of plant diversity, ecology, and distribution.

An introduction with general background is provided. It may serve as lecture material for the teacher or as reading/study material for the student. There are illustrations provided in the introduction and larger drawings in the appendix for the teacher to use in preparing trasparencies including some not in the written material.

Also in the appendix are the student objectives, learning activities, terms, bibliography, and supply list.

CARNIVOROUS PLANTS

Insectivorous or carnivorous plants are among the most interesting and unique plants in the world. These are the famous "man-eating" plants of science fiction fame. In actuality, there are no known carnivorous plants sufficiently large to consume a human. The group of insectivorous plants fall into 6 unrelated families and compromise nearly 500 species. Most, if not all, of these plants are adapted for survival without capturing prey. The prey seems to act as a diet supplement; some research has shown that survival for 15 years is possible without any meat in the diet for several of the plants. Most of these plants inhabit soil that is poor in nitrogen--peat bogs and heavy volcanic clays. (See Figure 1)

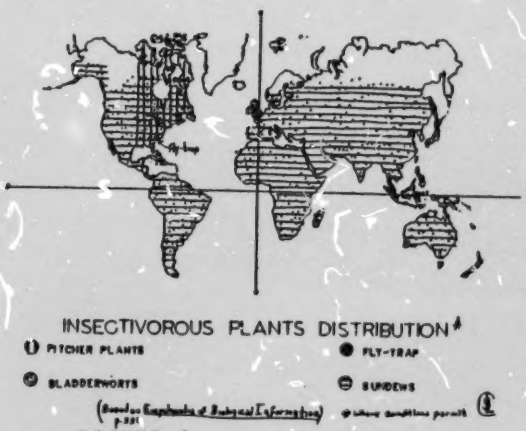


FIGURE 1.

The groups all have the ability to digest extracellularly- an oddity in the plant world; this digestion process takes different forms in the different families.

In some families digestion seems to be accomplished by proteolytic enzymes; in others there seems to be considerable bacterial action; and in still others, there is a combination of the two. The most important nutrients obtained from the animal bodies seem to be the nitrogeneous compounds. Several theories attempt to explain the evolution of the plants but none totally suffices. The evolutionary pattern is obviously parallel- none have extensive root systems, but all inhabit the same type areas; all have highly modified leaves. In this exercise only four species will be considered. They are SARRACENIA (pitcher plants), DROSERA (sundew), DIONEAE (Venus'-flytrap), and UTRICULARIA (bladderworts). (See Figure 2)

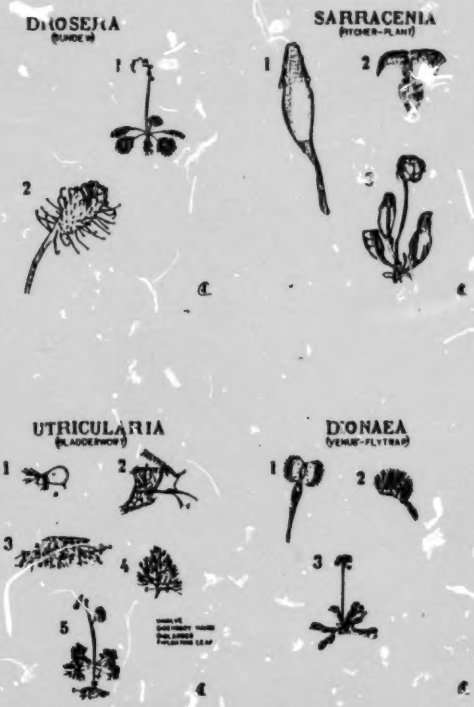


FIGURE 2.

Sarracenia or pitcher plant has a leaf modification with the leaf rolled into a tube or a sac. The upper part of the leaf is usually rolled into a highly colored lip or hood. This lip partly covers the opening into the tube. On the neck of the hood there are nectar glands which function to attract insects to the area. Once the insects get to the top they slip down the tube- upward mobility is limited by a series of downward pointing spines. The hapless insect ends up at the bottom of the sac where there is a pool of water, generally left from a rain, but sometimes a secretion of the plant itself. Various proteases then begin to act upon the insect. They are secreted into the water. The semi-digested proteins in the form of amino acids are absorbed by glands that line the base of the leaf. Leaves are generally clustered in a rosette (star-like) from which arises a flowerstalk up to a meter high. The bisexual flower is a solitary bloom with a pentamerous (5 part) arrangement of parts. One interesting modification of the bloom is its umbrella-shaped style which overlays the stamens. The style has five small stigma below the apices. Study of the drawing in Figure 3 can help in the recognition of the plant. Further pictures are to be found in the filmstrip and in the slides.

SARRACENIA
(PITCHER-PLANT)

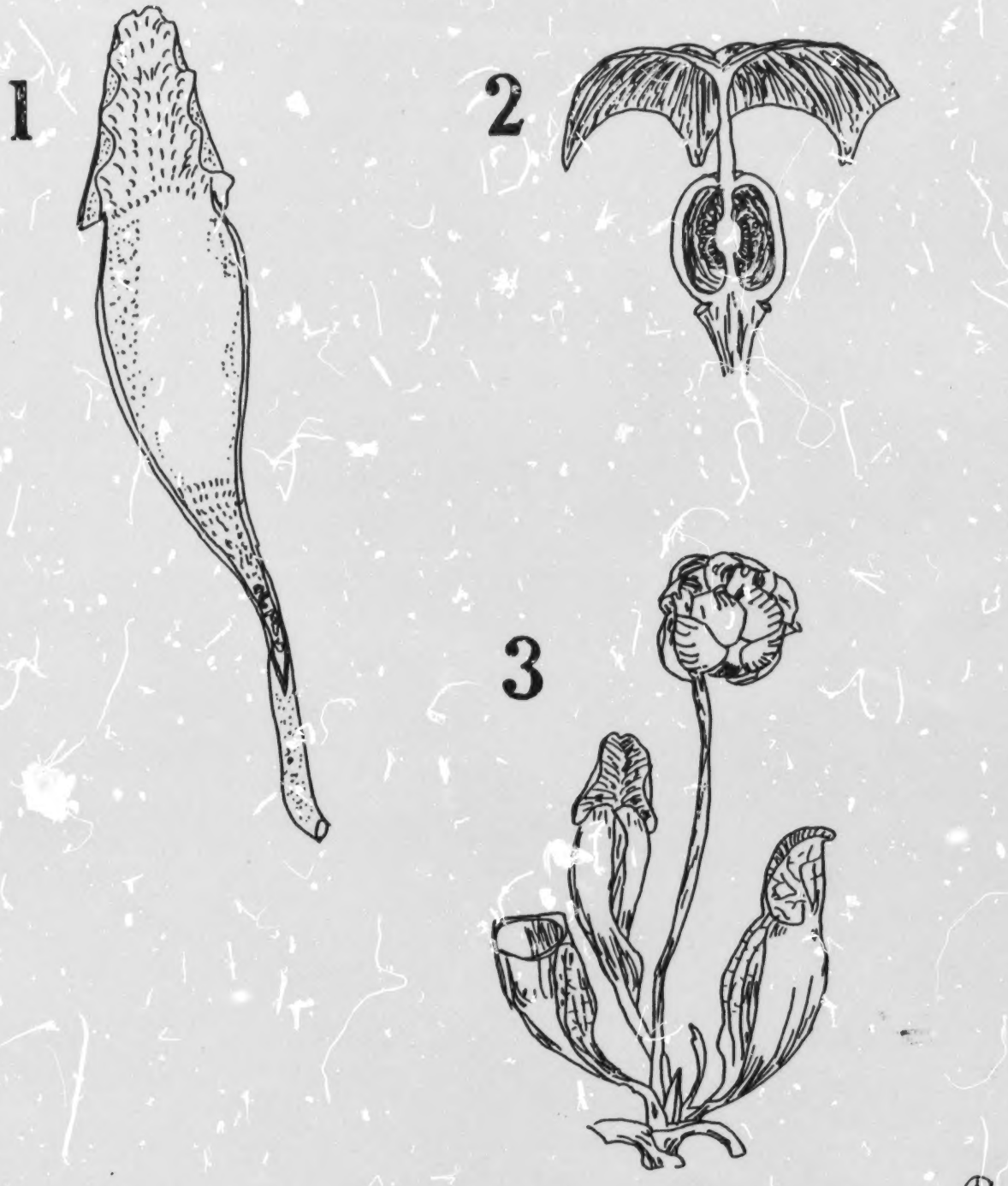


FIGURE 3.

Drosera or sundew is, generally, a much smaller plant than the pitcher plants, but it does not lack for highly specialized leaves. Depending upon the species, the leaves vary from narrow and thread-like to almost circular. All leaves bear numerous hair-like tenacles; each having a secretory gland at its base. The secretions are sticky in nature and evidence suggests direct tracheid connection giving rise to a sugary solution. These viscous drops glisten in the sun which is the reason for the plants common name. Once the insect has become stuck and struggles, near-by tenacles close over the prey by bending slowly. Several hours may be necessary before the insect is completely surrounded. The movements may be either chemonastic or thigmonastic or partly tropic or some combination. Whatever the reason the movement is accomplished through differential growth. Digestion occurs via enzymatic action. The enzymes are found in the secretions of the tenacles. Absorption of the digestion products is accomplished by specialized cells on the leaf's surface. Regular, bisexual, and generally pentamerous flowers arise on a long stalk from a basal rosette of leaves. See the drawings in Figure 4, filmstrip, and slides for illustrations.

DROSERA
(SUNDEW)

FIGURE 4.

Unique to the Carolinas' coast is Dioneae (Venus'-flytrap). All the other insectivorous plants have wide distributions but Dioneae is restricted to a very small area (see map). Like the two plants previously discussed, Venus'-flytrap has leaf modifications to capture and digest insects. The flytrap has an expanded blade with a hinge down the middle. The expanded part is further modified by stiff teeth which line the margins of each half. Inside each expanded half there are three trigger hairs. Cells of the leaf contain a red pigment, probably to attract insects. Some cells secrete a digestive fluid. When an insect triggers the leaf the halves snap closed interlocking the stiff marginal hairs to prevent escape. Preliminary closing takes only a second but complete closing may take several hours. The rapid movement of the leaf is not understood. Turgor pressure changes in the hinge area has been advanced as a possible explanation.

Growth results in the complete closing of the leaf. After a few days the leaf again opens and awaits another victim. Opening of the leaf is probably epinastic. Digestive fluids are secreted after the leaf is closed and the amino acids are absorbed by surface glands. The leaves are arranged in a rosette varying in height from 5 cm. to 15 cm. The flower stalk bearing an umbel-like cyme arises from the rosette. This plant is so unique and rare that a prohibition against collecting is necessary. It can be obtained from many commercial sources. See the illustrations in Figure 5.

FIGURE 5.

Last of the plants to be discussed is Utricularia or bladderwort. This carnivorous plant differs from all the others in that it is totally submerged and rootless. The bladders from which the plant gets its name are borne on finely divided leaves. There may be hundreds or even thousands on a plant depending on the health of the plant. The bladder is a marvel of construction- it sets its traps by expelling most of the water inside. When an organism touches one of the four sensitive hairs the valve opens and the in-rush of water pulls the unsuspecting prey inside. The valve then snaps closed immediately thus trapping the prey. Digestion seems to be by proteolytic enzymes and some bacterial action. Each of the bladders is of 0.8 mm by 0.6 mm (average) so the prey is generally small--water fleas and other copepods. The flower of the bladderwort is aerial and generally supported by floating leaves. The flower is bisexual, sometimes solitary, but generally in a raceme or spike. Many of the specialized features discussed can be seen in the illustrations in Figure 6.

FIGURE 6.

Many insectivorous plants fall prey to collectors who have no regard for an undisturbed ecosystem; others fall prey to swamp and bog drainage; some are killed by trampling by the so-called "back-to-nature" people who don't know what they are doing when they hike about. Admittedly there is no great economic value in any of these plants - the leaves of Drosera were once used to make a purple dye and Dioneae are sold to terrarium enthusiasts but one would be hard put to explain the rise of the American economy in terms of the preservation of any of these insectivorous plants! The question of this lesson is to determine whether we need concern ourselves over something of so little importance economically. Does a callous act toward this group of plants indicate a general disregard for natural conditions? A right or wrong answer to this does not exist; it all depends on one's values.

A. BEHAVIORAL OBJECTIVES: At the end of a successful lesson the student should be able to:

1. Identify by sight the four plant types discussed in the lesson.
2. Describe the leaf modifications of each of the four types.
3. Describe the function of each leaf modification.
4. Compare and contrast the various habitats of the four plants discussed.
5. Postulate reasons for the geographical distribution of the various insectivorous plants.
6. Postulate various evolution senarios to describe the plants today.

B. ACTIVITIES:

1. Observe preserved specimens, 2x2 slides, filmstrip, and diagrams of the plants. Note particularly the habitats of the plants for similarities.
2. Using some good general reference book (q.v. Encyclopedia Britannica or a general botany book) look up each of the four plants discussed in the introduction.
3. Using the bulletin board illustrate the leaf modifications described in the introduction or found through research (#2).
4. Carry activity #3 a step further and illustrate the functional aspect of each modification. (NOTE: this requires thinking!!)
5. Research the habitats of the four plants discussed and prepare a table showing similarities and differences. If possible visit areas to see the plants in their natural conditions. View the slides and filmstrip again for visual information.
6. With a blank world map and a table of the 16 major species (table in Handbook of Biological Data p. 330) place on the may the distribution of these plants. Prepare a classroom map.

7. Research evolution and with what you learn write an essay explaining the possible evolution of these groups of plants. Read your essay to the class and get their criticism.

C. VALUES CLARIFICATION ACTIVITIES:

1. Role Playing- Situation: a lumber company has plans in to the coastal region of N.C. where there is a very high rate of unemployment. The company has plans for a reforestation program and a resort hotel. Many people will be employed by this endeavor. Act out the following roles:
   a. conservationist
   b. lumber interest
   c. garden club member
   d. biologist
   e. inhabitant of area
   f. unemployed worker

   These persons have meet at a hearing on the request to proceed with the project. They are standing around the coffee pot.

2. Alternatives Search- The lumber company in #1 above has received permission to proceed with its plans. Your problem is to come up with various contigency plans. In other words what you would do if no court order can be gotten... shoot the lumbermen, pull up the flytraps, burn the area, what? After listing your plans share them with another group of students.. criticize.

3. Rank Order-- In the following sets there are three choices rank them in the order that means the most for you.

   ----undisturbed habitat for Venus'-flytrap
   ----spraying for mosquitos
   ----clearing the land for lumbering

   ----motor-boating
   ----bladderworts flowering
   ----undisturbed swimming

   ----herbarium collector collecting
   ----undisturbed Venus'-flytrap plants
   ----terrarium builder collecting plants (commercial scale)

D. TERMS TO KNOW

.peat bogs
.extracellular digestion
.nitrogeneous compounds
.rosette
.style
.stigma
.stamens
.chemonastic
.thigmonastic
.tropic
.epinastic

E. BIBLIOGRAPHY:

Taxonomy of Vascular Plants, George Lawrence, Macmillan, 1970.

Manual of Vascular Plants, Henry Gleason, Van Nostrand, 1963.

Botany, Carl L. Wilson, Dryden Press, 1957.

Biological Science, William Keeton, W.W. Norton, 1967.

Handbook of Biological Data, P. 330.

Carolina Tips, Jon Hooft, Dec. 1, 1974, Vol. XXXVII, no. 15.

F. SUPPLIES NEEDED:

Numbers given are for materials from Carolina Biological Supply, Burlington, N.C. 27215. Other suppliers have these materials. PB 633 Insectivorous Plants Set
52-8710 Carnivorous Plants Filmstrip
Many other items useful in this encounter are available see their catalogue.

G. PLANT CHARACTERISTICS

Species	Geographic Distribution	Specialized Structures	Remarks
1. Sarracenia spp[2]	Eastern North America	Pitcher-like leaves 10-40 cm long when mature, lined with "nectar" glands, unicellular hairs, "digestive" glands; non-cuticular "absorptive" areas present.	Absorption of liquid from pitchers has been demonstrated. pH of pitcher contents in the field varies from 2 to 8. Mature pitchers contain considerable amounts of decayed insect residues. Presence of various enzymes, i.e., maltase, lipase and proteinases, reported in pitcher liquid. Role of bacteria in digestion of animal "prey" not determined.[3]

Plant characteristics cont.

Species	Geographic Distribution	Specialized Structures	Remarks
2. Dionaea muscipula (Venus fly-trap)	Peat bogs of North and South Carolina	Leaves bilobed, with marginal spines and six "trigger" hairs in center of upper surface. Upper leaf-surface bears "nectar" glands and "digestive" glands, both types sessile.	When an insect comes in contact with a trigger hair, the leaf-lobes close rapidly (0.25 sec), forming with the marginal spines a box-like structure within which the "prey" may be entrapped. Closure is followed by the secretion of an acid substance in which various proteolytic enzymes have been reported. Role of bacteria in digestion uncertain. Absorption of products of digestion reported; significance on nutrition not determined.
3. Drosera	World-wide.	Leaves orbiculate, spatulate or linear, 2-35 cm long, with tentacles yielding a viscid secretion.	Tentacles inflect to cover insects entrapped in tentacular secretion. Secretion contains sugars and enzymes capable of proteolysis at pH 2. Digestion independent of bacterial action; absorption not clearly demonstrated.[6]

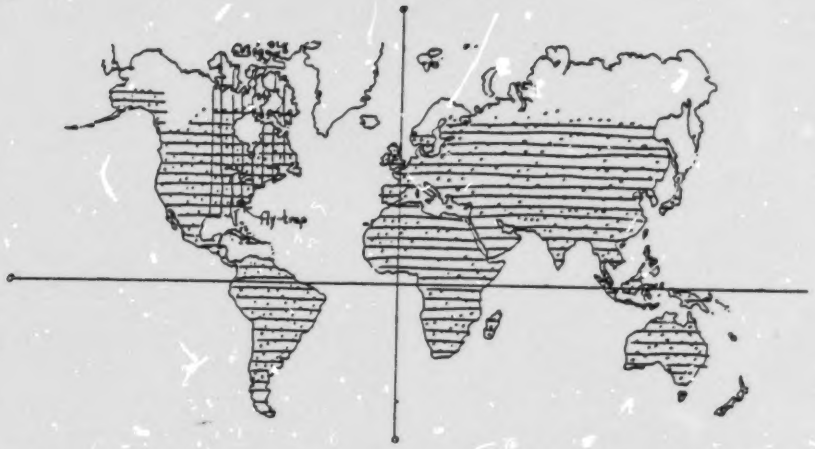
Plant characteristics cont.

Species	Geographic Distribution	Specialized Structures	Remarks
4.Utricularia	World-wide	Aquatic Plants bearing on submersed portions small vesicles or "bladders" lined with glandular hairs. Absorption of water within bladders leads to formation of a partial vacuum; a door closes the bladder. On the outer surface of the door are 4-6 "tripping" hairs or bristles.	When an aquatic insect encounters the tripping hair, the door opens and the inrushing water carries the insect into the bladder. After an interval the partial vacuum is reestablished, again setting the trap. Entrapped insects disintegrate and are apparently absorbed. Bacterial action not determined.

FROM THE HANDBOOK OF BIOLOGICAL DATA, PAGE 330.

APPENDIX

ILLUSTRATIONS



INSECTIVOROUS PLANTS DISTRIBUTION*

- PITCHER PLANTS
- BLADDERWORTS
- FLY-TRAP
- SUNDEWS

(Based on Encyclopedia of Biological Information) p.330

*where conditions permit

DROSERA
(SUNDEW)

SARRACENIA
(PITCHER-PLANT)

UTRICULARIA
(BLADDERWORT)

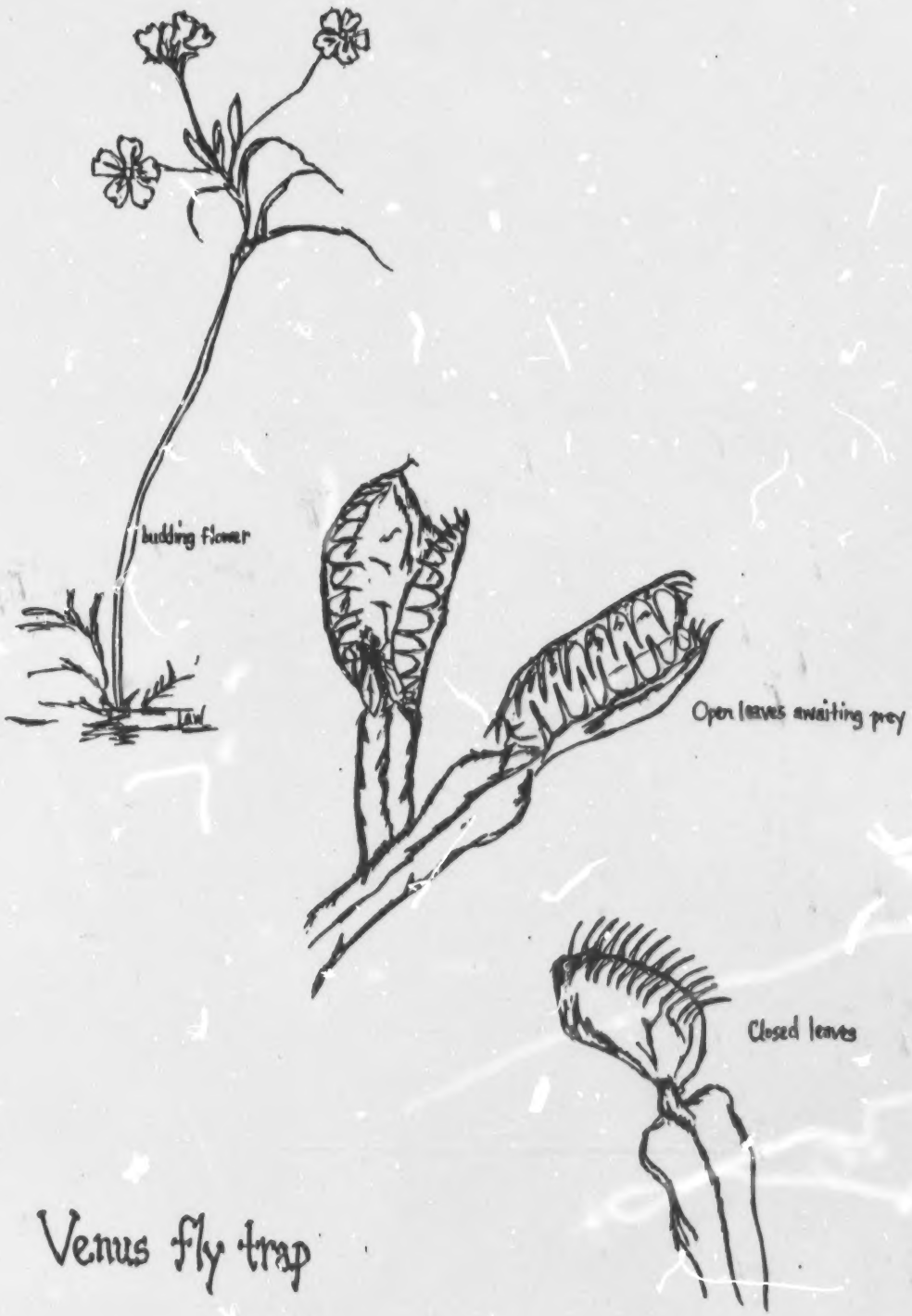
DIONAEA
(VENUS'-FLYTRAP)

DIONAEA
(VENUS'-FLYTRAP)

1

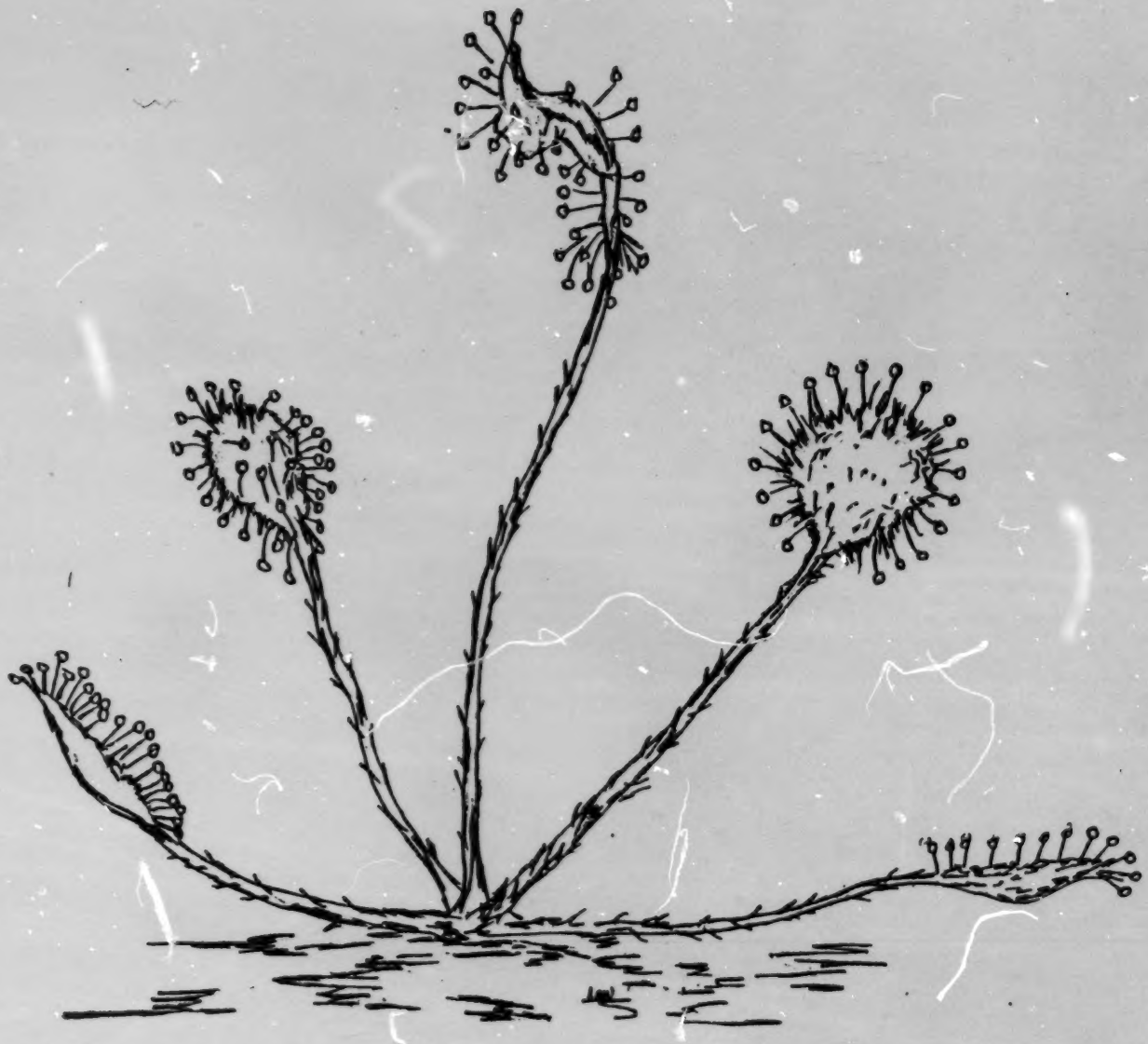
2

3



Venus fly trap

GREEN

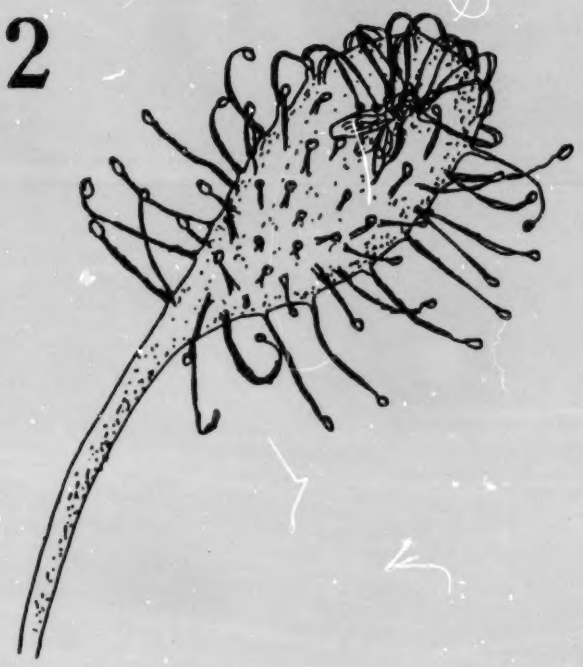


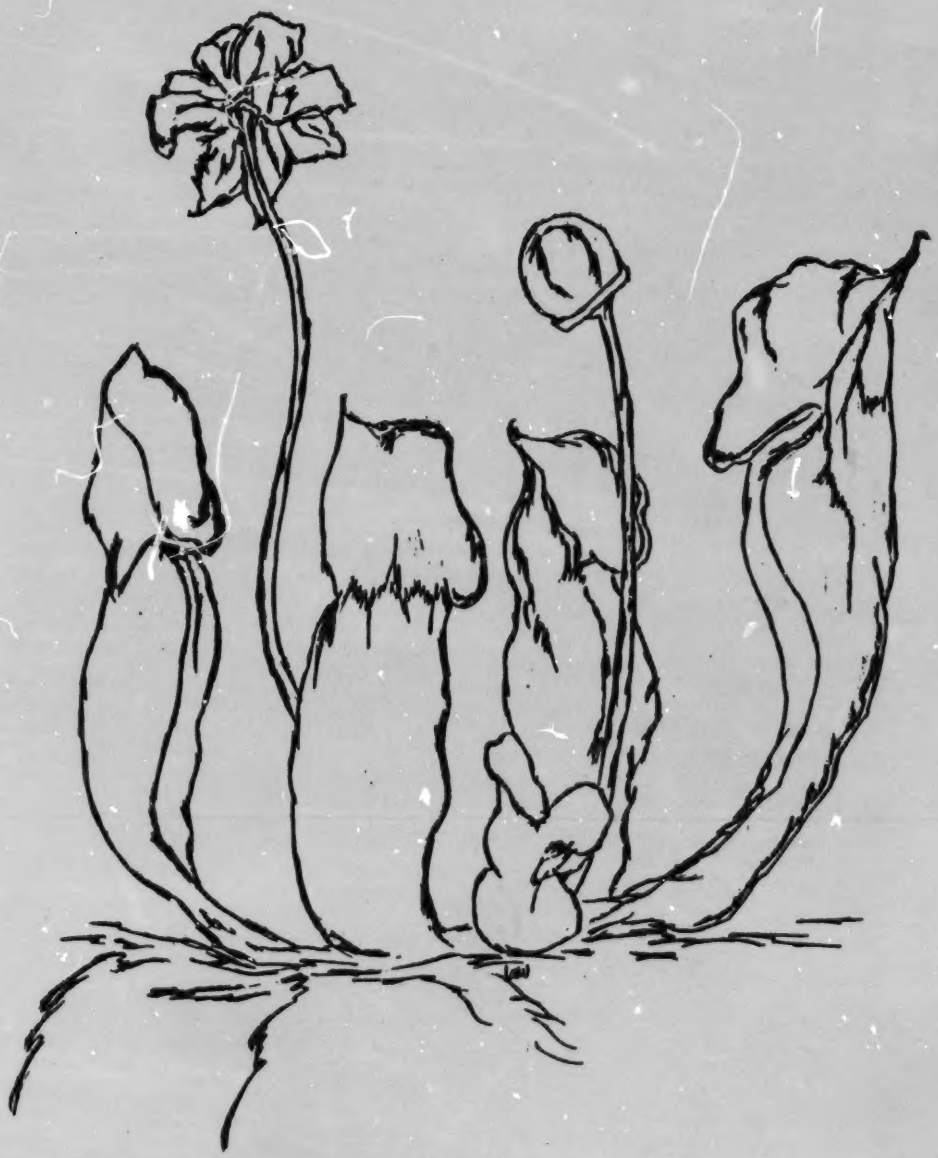
Sundew

DROSERA
(SUNDEW)

1

2





Pitcher plant

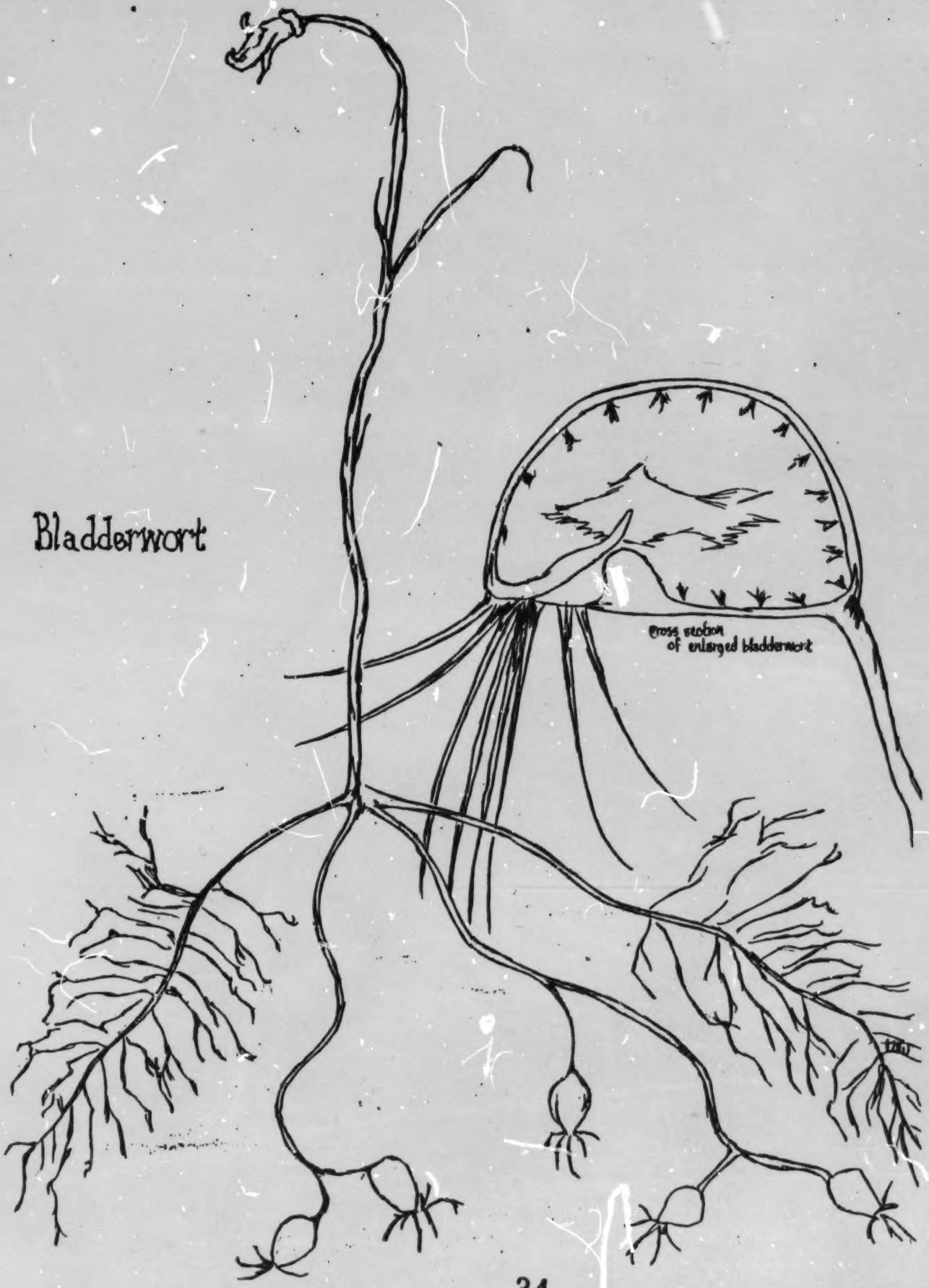
SARRACENIA
(PITCHER-PLANT)

1

2

3

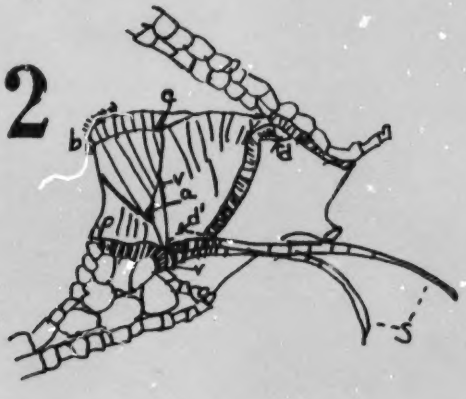
Bladderwort



UTRICULARIA
(BLADDERWORT)

1

2

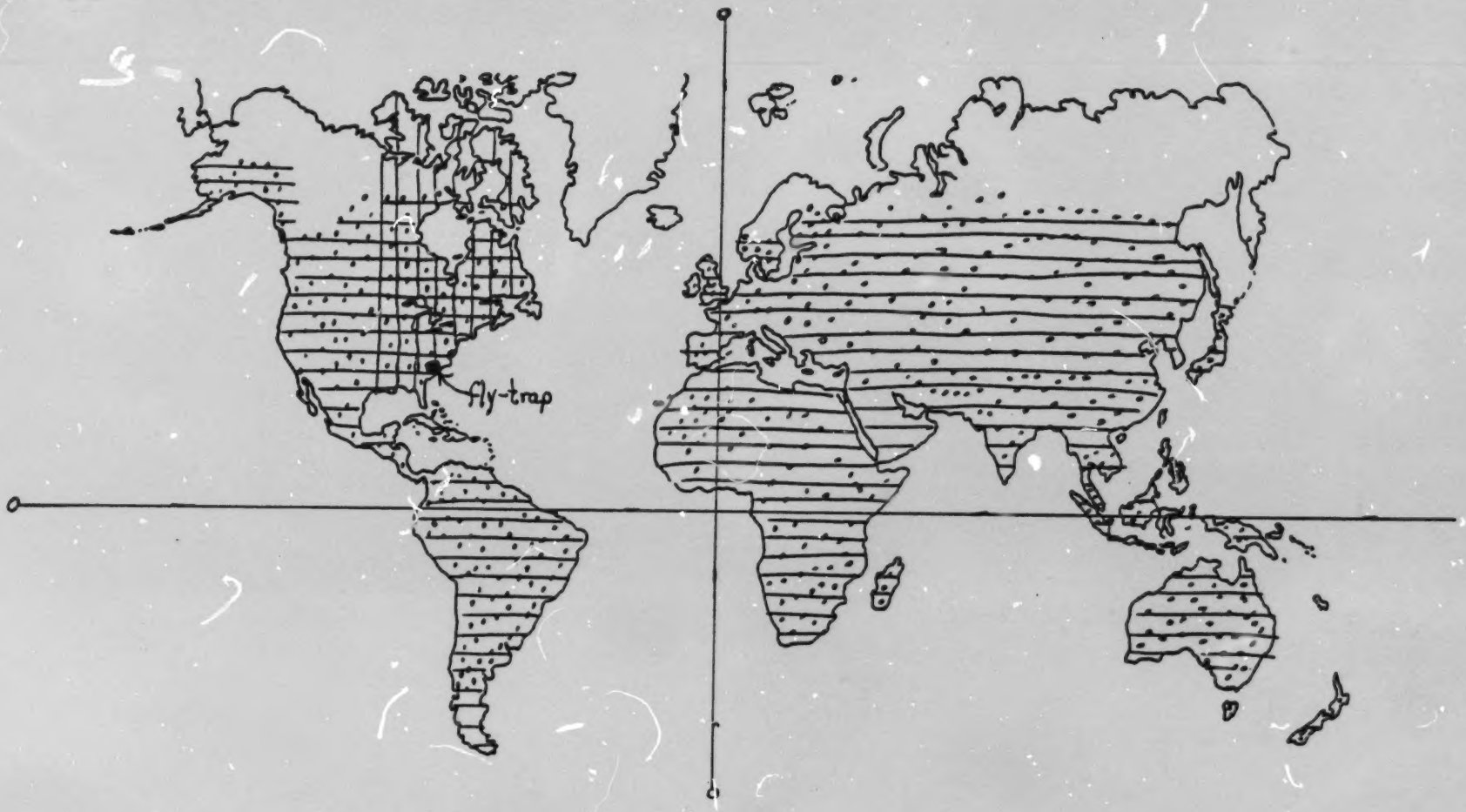


3

4

5

V=VALVE
S=SENSORY HAIRS
B=BLADDER
F=FLOATING LEAF



INSECTIVOROUS PLANTS DISTRIBUTION*

PITCHER PLANTS

BLADDERWORTS

FLY-TRAP

SUNDEWS

(Based on Encyclopedia of Biological Information p.330

* where conditions permit